NOTES 14: P-VALUES AND SIGNIFICANCE

Stat 120 | Fall 2025
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Last time, we laid out the following steps for setting up a hypothesis test:

1. Formulate hypotheses in terms of population parameter
2. Collect data and compute a sample statistic
3. Use the sample statistic to make a claim about the hypotheses

Today, we're diving into step 3:

    3a. Construct null distribution

    3b. Compute p-value

    3c. Make a decision about H_0

0.1 For our study on F's
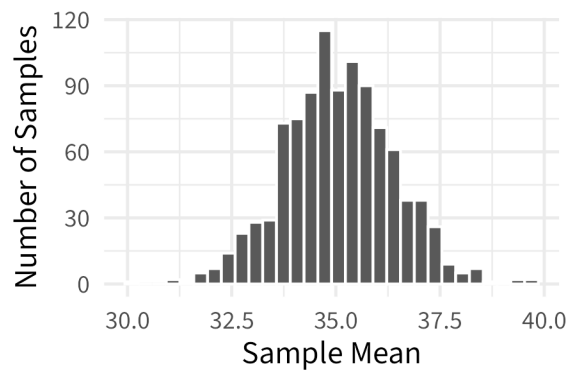
Population parameter: μ

Sample statistic: $\bar{x}$

$H_0 : \mu = 35$

$H_A : \mu < 35$

Null Distribution:

How do we construct a null distribution?

StatKey Example: In a random sample of 765 adults in the United States, 322 say they could not cover a $400 unexpected expense without borrowing money or going into debt. A journalist claims that this is evidence that the overall proportion could be 50%. Is the journalist justified?

R "Paper" Example: A public health researcher believes that there is a positive relationship between heart rate and age among ICU patients. Data from 23 patients gives $r = 0.037$.
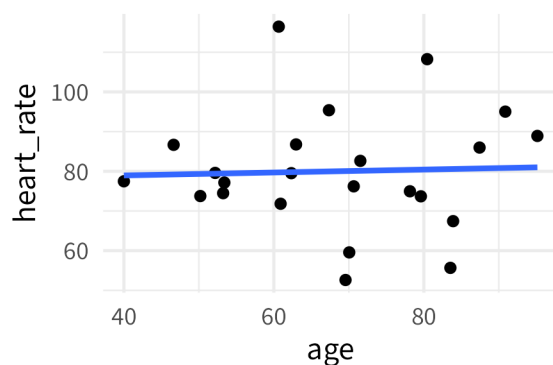

```
# A tibble: 23 x 2
      age heart_rate
    <dbl>      <dbl>
 1  70.7       76.2
 2  87.4       86.0
 3  67.3       95.4
 4  80.4      108.
 5  95.1       88.9
 6  60.7      116.
 7  83.9       67.4
 8  79.6       73.7
 9  90.9       95.0
10  62.3       79.5
# i 13 more rows
```

```
library(CarletonStats)
permTestCor(heart_rate ~ age, data = icu, alternative = "greater")
```

```
   ** Permutation test **

 Permutation test with alternative: greater
 Observed correlation between age ,  heart_rate : 0.037
 Mean of permutation distribution: -0.00652
 Standard error of permutation distribution: 0.2069
 P-value:  0.413

   *-------------*
```

Permutation distribution

R Example: In a pre-Musk Pew Research Poll on social media use, 72% of Twitter users (n = 346) responded that they visited Twitter a few times a week or more. Among Instagram users (n = 530), this number was 80%. Is there a difference in frequency of use between Twitter and Instagram users?

```
permTest(visits ~ app, data = social_media)
```

```
   ** Permutation test **

 Permutation test with alternative: two.sided
 Observed statistic
  instagram :  0.8   twitter :  0.7197
 Observed difference: 0.08035

 Mean of permutation distribution: -0.00025
 Standard error of permutation distribution: 0.02929
 P-value:  0.004

    *-------------*
```

Permutation distribution

1 Statistical Significance

Significance Level

Statistical Significance

Formal Statistical Decisions

2 Summary

Whenever performing a hypothesis test, you should:

(1) Perform an appropriate EDA

(2) Formulate H_0 and H_A

(3) Compute a test statistic

(4) Construct a null distribution

(5) Compare the test statistic to the null distribution and compute a p-value

(6) Make a decision (reject or fail to reject) about H_0

(7) Report your conclusion in context